

## Agronomic Characteristics Of Three Flax Varieties As Affected By Some Sources Of Potassium Fertilization Under Newly Reclaimed Sandy Soil Conditions

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**Abstract:** Response of three flax (Giza-8, Vaiking and Eriana) varieties to foliar application with four sources of potassium fertilization i.e. (KOH, KNO<sub>3</sub>, K<sub>2</sub>SO<sub>4</sub> and KCl) were investigated during the two successive seasons, 2009/2010 and 2010/2011 in sandy soil conditions at the Experimental Farm of the National Research Centre, Nubaria District, El-Behira Governorate, Egypt. Results show that significant differences among flax varieties in all studied characteristics. Giza-8 variety surpassed all other tested flax varieties in seed and oil yields/fed., number of capsules/plant, number of branches/plant, seed yield/plant (g), and oil seed %. However, Vaiking variety significantly exceeded the other cultivars in straw and fiber yields/fed., plant height (cm), fruiting zone length (cm) and fiber %. Results indicated that KNO<sub>3</sub> utilization as foliar application significant caused the highest increases in the studied characteristics except technical length. The data reported that the greatest straw yield (tons/fed) and fiber yield (kg/fed) were obtained when Vaiking variety sprayed by KNO<sub>3</sub> fertilizer. While the best results of seed yield (Kg/fed.) and oil yield (kg/fed.), were achieved with Giza-8 variety by using the same fertilizer. It could be concluded that planting Giza-8 as flaxseed variety for production seed and oil yields however, sowing Vaiking variety as fiber flax variety for fiber yield production when they fertilized by KNO<sub>3</sub> foliar application under newly reclaimed sandy soil conditions.

**Key words:** Flax varieties, Potassium fertilization, quality traits

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### INTRODUCTION

Flax (*Linum usitatissimum* L.) is a source of two products; flaxseed for oil and fiber for linen products. In Egypt, it is an old economic crop grown as a dual purpose crop for seeds and fibers which is used for the manufacture of linen

Many investigators reported significant differences among flax varieties concerning seed, straw, oil and fiber yields and there components (El-Hariri, *et al.*, 1996, 1998 and 2004).

Concerning to flax varieties, (Gaffer *et al.* 1985) found that flax varieties differed significantly in yield and its components.

Potassium (K) is recognized as an essential nutrient to flax plant for many physiological processes and reactions which affected plant growth and development. Generally, the plants response to K fertilizers might be due to the soils with high fixing capacity (Page *et al.*, 1963), the soil texture is sandy, intensive cropping system, the introduction of high yielding varieties, the increment in nitrogen doses applied in crop management (Oosterhuis *et al.*, 1991 and Tupper *et al.*, 1991).

Most of responses to K fertilization were found with soil applied treatments. However, responses to K foliar application have also been reported. (Abd El-Aal *et al.*, 1995b) observed yield improvement in plants fertilizer with both soil and foliar applied K alone. Foliar application of K may offer the opportunity of correcting these deficiencies more quickly and efficiently, especially late in the season when soil application of k may not be effective or when tissue analysis indicates a pending shortage and thereby correct the deficiency and prevent yield loss (Oosterhuis, 1998).

The objective of this investigation was to study the effect of five sources of potassium fertilization on the agronomic characteristics of three flax varieties.

### MATERIALS AND METHODS

Two field experiments were conducted at the Experimental; Farm of the national Research Centre, Nubaria District, Behira Governorate, Egypt, during 2009/2010 and 2010/2011 growing seasons to study the response of three flax varieties to four sources of potassium fertilization.

Each experiment includes 15 treatments which were the combinations of three flax varieties and four sources potassium with control:

**A. Potassium fertilization :**

- Control
- KOH
- KNO<sub>3</sub>
- K<sub>2</sub>SO<sub>4</sub>
- KCl

**B. Flax varieties :**

- Vaking (fiber crop)
- Eriand (oil crop)
- Giza-8 (double purpose)

The split-plot design with four replications in both seasons was used. The main plots were occupied by the varieties, whereas the four sources of potassium fertilization were arranged at random in sub-plots. The sub plot was 6 m<sup>2</sup> (3x2 m) area (1/700 fed). Flaxseeds were sown in the mid of November in both seasons in 10 rows 3 m long and 20 cm apart.

The soil was sandy in texture with pH of 8.83, CaCO<sub>3</sub>% of 4.8 (O.M% of 0.24) and containing 0.22, 10.18, 92.0, 18.4 and 12.36 mg/100 g soil P, K, Ca, Mg and Na respectively. In addition, 8.92, 8.34, 0.13 and 0.10 mg/kg soil Fe, Mn, Zn and Cu respectively. Each treatment fertilized by 100 Kg P<sub>2</sub>O<sub>5</sub>/fed. as calcium super phosphate (15.5/ P<sub>2</sub>O<sub>5</sub>) during land preparation and 40 g N/fed. as ammonium nitrate (33.5% N) split into five equal doses after complete germination and after two weeks from that.

The four sources of potassium fertilization were (KOH, KNO<sub>3</sub>, K<sub>2</sub>SO<sub>4</sub> and KCl) as foliar application with rate 800 ppm K<sub>2</sub>O before flowering stage and in the stage of capsules filling. All cultural practices were carried out as usual. At full maturity stage (middle of May), ten guarded plants were taken at random from each sub plot to estimate plant height (cm), technical stem length (cm), number of fruiting branches /plant, numbers of capsules /plant and seed and straw yield/plant (g). Seed and straw yields/fed. were estimated from the central area of one square meter of each sub plot. Plants were harvested, tied and left to dry, capsules were removed carefully to determine straw yield and then converted to straw yield in (ton/fed.), Seeds were cleaned from straw and other residuals and weighed to the nearest gram and converted to record seed yield in (kg/fed.), and then straw retting was carried out at Tanta flax and oil Company using warm water retting system under controlled condition (30 – 35 C °).

Seed oil % was determined by soxhlet apparatus using petroleum ether (40-60 OC b.p) according to the Official Method A.O.A.C. [1980]. Oil yield (kg/fed) was calculated by seed yield (kg/fed) X Seed oil (%).

Fiber percentage was calculated by (weight of total fiber (g) / weight of straw after retting (g)) X 100. Fiber yield (kg/fed.) was calculated by straw yield (kg/fed) X fiber (%).

Data of the experiments were subjected to statistical analysis with the computer. The combined analysis was conducted for the data of the two experiments according to Snedecor&Cochran (1968). The least significant differences (L.S.D.) was used to compute the means. All statistical analysis was performed using the facility of computer and Co-stat program computer software package.

## RESULTS AND DISCUSSION

**a. Varietal effect:**

The data presented in Table (1) showed that yield and yield components of the studied varieties differed significantly in all characters under this trails. Giza-8 variety surpassed all other tested flax varieties in seed yield (577.94 kg/fed.) and oil yield (225.54 kg/fed.) The superiority of this variety may be due to the highest values of numbers of capsules/plant (14.47), number of branches/plant (4.05), seed yield/plant (0.28 g) and oil seed % (38.91). Such results are in agreement with those obtained by El-Hariri, *et al.*, 1998, Sorour, *et al.*, 1992 and Gaffer, *et al.*, 1985) who reported that the flax cultivars differed in seed yield productivity.

Vaiking variety significantly exceeded the other cultivars in straw yield (2.689 tons/fed) and fiber yield (374.53 kg/fed). This result maybe due to the highest values of plant height (67.95 cm), fruiting zone length (22.15 cm) and fiber % (13.89). The obtained findings are in agreement with those gained by other investigators El-Hariri, *et al.*, 1996, 1998 and 2004) they showed that there were large differences in straw yield and its components among flax genotypes. These results indicated that the variability among tested flax varieties which may be expected due to the differences of these varieties in origin, growth habit, the high diversity in genetic constituent and the environmental conditions of investigated cultivars under newly reclaimed sandy soil.

**Table 1:** Effect of flax varieties on seed, straw, oil and fiber yields and there components.(combined 2009/2010 and 2010/2011 seasons).

Characters	Varieties			LSD <sub>0.05</sub>
	Vaiking	Giza -8	Eriana	
Plant height (cm )	67.95	65.10	59.86	1.83
Technical length (cm)	45.80	50.32	43.09	2.30
Fruiting zone length (cm)	22.15	14.78	16.77	1.21
No. of capsules /plant	9.20	14.47	7.07	1.09
No. of branches /plant	3.12	4.05	3.16	0.11
Seed yield/ plant (g)	0.20	0.28	0.16	0.02
Straw yield/ plant (g)	1.22	1.26	1.00	0.03
Seed yield (kg/fed)	449.33	577.94	401.08	8.45
Straw yield (ton/fed)	2.689	2.430	2.590	0.10
Oil seed percentage	38.42	38.91	38.28	0.12
Oil yield (kg/fed)	173.45	225.54	154.16	2.33
Fiber percentage	13.89	13.90	13.65	0.05
Fiber yield (kg/fed)	374.53	337.92	354.19	3.17

### b. Effect of potassium sources:

Results presented in Table (2) indicated that all potassium sources were significantly affected in all plant studied characteristics except technical length. KNO<sub>3</sub> treatment surpassed the other treatment in seed yield (572.09 kg/fed.) and oil yield (231.09 kg/fed). This results may be due to the highest obtained values of plant height (67.69 cm), fruiting zone length (21.92 cm), numbers of capsules/plant (13.33), number of branches/plant (4.43), seed yield/plant (0.26 g) and oil seed % (40.40). In addition, results indicated that the high straw and fiber yields (2.921 tons/fed) and (414.72 kg/fed.) in respectively, were obtained by KNO<sub>3</sub> treatment. This superiority was due to the highest values of plant height (67.69 cm), straw yield/ plant (1.26 g) and fiber % (14.19). These results are in agreement with those obtained by El-Hariri, *et al.*, (1998), these effects are due to (K) role in formation of carbohydrates, proteins, photosynthesis translocation regulation, enzyme action, synthesis of nucleic acid, chlorophyll, oxidative, photophosphorylation and translocation of solutions (Pandy and Sinha, 1978).

Over all studied data in Table (2) show that generally, KNO<sub>3</sub> was the best results with all studied characteristics. However, KOH was the opposite. In this respect, (Oosterhuis *et al.*, 1990, 1991b, 1992, 1993; Roberts *et al.*, 1993), indicated that foliar application of KNO<sub>3</sub> can increase cotton yields and improve lint quality. In addition, (Miley and Oosterhuis 1994), found that KCl had no effect on yield. Also, (Pettiet, 1993), reported that KCl dissolved more easily than KNO<sub>3</sub> and was more easily observed by the leaf; however, the effects on yield were not recorded. In the other hand, (Jones *et al.*, 1993), indicated that there were no significant differences among cotton cultivars in response to foliar applied KNO<sub>3</sub>.

**Table 2:** Effect of some sources of potassium fertilization on seed, straw, oil and fiber yields and there components. (Combined 2009/2010 and 2010/2011 seasons).

Characters	Sources of potassium					LSD <sub>0.05</sub>
	Control	KOH	KNO <sub>3</sub>	K <sub>2</sub> SO <sub>4</sub>	KCL	
Plant height (cm )	60.72	64.74	67.69	63.70	64.66	0.30
Technical length (cm)	45.72	47.37	45.77	46.74	46.43	n.s
Fruiting zone length (cm)	15.00	17.38	21.92	16.97	18.23	1.32
No. of capsules /plant	7.00	9.61	13.33	11.08	10.19	0.57
No. of branches /plant	2.57	3.47	4.43	3.38	3.37	0.03
Seed yield/ plant (g)	0.16	0.21	0.26	0.23	0.22	0.01
Straw yield/ plant (g)	1.05	1.17	1.26	1.17	1.14	0.02
Seed yield (kg/fed)	387.05	470.94	572.09	502.21	448.29	16.14
Straw yield (ton/fed)	2.184	2.624	2.921	2.631	2.490	0.06
Oil seed percentage	36.80	37.88	40.40	39.09	38.52	0.43
Oil yield (kg/fed)	142.89	178.47	231.09	196.43	173.03	4.21
Fiber percentage	13.35	13.85	14.19	13.88	13.79	0.03
Fiber yield (kg/fed)	291.27	363.42	414.72	364.95	343.36	7.18

### c. Interaction effect:

Results in Table (3) showed that there was significantly affect of interaction between the sources of potassium fertilization and the tested flax varieties for all the studied characteristics. KNO<sub>3</sub> fertilizer, recorded superiority among all sources of potassium fertilization with flax varieties. The greatest straw yield (3.211 tons/fed) and fiber yield (460.49 kg/fed) were obtained when sowing Vaiking variety and sprayed the plants by KNO<sub>3</sub> fertilizer. This was due to the obtained highest values of plant height (72.13 cm), fruiting zone length (26.05 cm), straw yield/plant (1.37 g) and fiber percentage (14.34). While the best results of seed yield (665.58 Kg/fed.) and oil yield (271.29 kg/fed.), were achieved by planting Giza-8 variety with the same fertilizer. This superiority was due to the highest values of number of capsules/ plant (20.0), number of branches/ plant (5.2) and seed yield/ plant (0.34 g).

From the aforementioned results it can be recommended that under the condition prevailing in the site of experiments and for improving all characteristics of flax plant, it is necessary to use  $KNO_3$  fertilizer and chose the high yielding ability varieties in seed, oil and fiber yields.

It could be concluded for this study to expanding of flax cultivation under such desert newly reclaimed sandy soil conditions. Also, some exotic varieties can perform well and outyielded in the production for seed, oil and fiber yields. Giza-8 variety produced the highest seed and oil yields per feddan when it was seeded and fertilized by the form of  $KNO_3$  as foliar application and significantly outyielded the other interactions, therefore it can be recommended as flax-seed variety. However, Vaiking variety produced high straw and fiber yields per feddan when it was seeded and fertilized by the form of  $KNO_3$  as foliar application, so that it can be recommended as fiber flax variety.

**Table 3:** The effect of interaction between the flax varieties and the sources of potassium. (Combined 2009/2010 and 2010/2011 seasons).

Varieties	Potassium Sources	Plant height (cm)	Technical length (cm)	Fruiting zone length (cm)	No. of capsules /plant	No. of branches /plant	Seed yield/ plant (g)	Straw yield/ plant (g)	Seed yield (kg/fed)	Straw yield (ton/fed)	Oil %	Oil yield (kg/fed)	Fiber %	Fiber yield (kg/fed)
Vaiking	Control	65.11	46.90	18.21	6.50	2.50	0.15	1.10	325.32	2.386	36.25	117.93	13.03	310.85
	KOH	68.23	47.98	20.25	9.25	3.00	0.20	1.25	432.08	2.701	38.17	164.92	13.97	377.26
	$KNO_3$	72.13	46.08	26.05	11.00	4.00	0.24	1.37	562.55	3.211	39.41	221.70	14.34	460.49
	$K_2SO_4$	67.15	45.00	22.15	10.00	3.10	0.22	1.21	483.28	2.658	39.19	189.40	14.21	377.71
	KCL	67.14	43.06	24.08	9.25	3.00	0.21	1.18	443.43	2.492	39.08	173.29	13.9	346.34
Giza-8	Control	59.43	47.18	12.25	8.75	2.85	0.22	1.15	480.33	2.015	37.77	181.42	13.69	275.85
	KOH	66.25	51.02	15.23	12.33	4.12	0.26	1.28	540.12	2.559	38.15	206.06	13.79	352.89
	$KNO_3$	68.32	49.15	19.17	20.00	5.20	0.34	1.35	665.58	2.643	40.76	271.29	14.19	375.01
	$K_2SO_4$	65.18	52.09	13.09	16.25	4.00	0.31	1.27	643.17	2.535	39.17	251.93	13.97	354.14
	KCL	66.31	52.16	14.15	15.00	4.10	0.29	1.24	560.50	2.397	38.72	217.03	13.84	331.69
Eriana	Control	57.62	43.07	14.55	5.75	2.35	0.11	0.90	355.50	2.152	36.38	129.33	13.34	287.11
	KOH	59.75	43.10	16.65	7.25	3.30	0.16	0.98	440.62	2.611	37.32	164.44	13.79	360.13
	$KNO_3$	62.63	42.08	20.55	9.00	4.10	0.20	1.07	488.13	2.909	41.03	200.28	14.05	408.66
	$K_2SO_4$	58.78	43.12	15.66	7.00	3.05	0.17	1.02	380.18	2.699	38.92	147.97	13.45	362.99
	KCL	60.52	44.07	16.45	6.33	3.00	0.16	1.01	340.95	2.581	37.77	128.78	13.64	352.06
LSD <sub>0.05</sub>		0.89	0.13	1.33	0.37	0.23	0.02	0.01	3.43	0.121	0.32	2.15	0.01	1.87

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